Combined heat and power in hospitals

BEST PRACTICE PROGRAMME

ENERGY EFFICIENCY

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GOOD PRACTICE GUIDE 267

CONTENTS

1 INTRODUCTION

WHY COMBINED HEAT AND POWER?

- It saves money by reducing the amount of energy that you purchase.
- It improves reliability by supplementing your existing systems.
- It promotes a healthier environment by reducing emissions to the atmosphere, and helping to prevent climate change.

This Guide provides an overview of the issues surrounding combined heat and power (CHP) in hospitals. The guidance and case studies will prove useful to those involved in the management of hospital estates and finances, whether already knowledgeable about CHP or a complete newcomer to the subject. This is not a technical guide; those seeking technical detail are referred to the organisations and publications listed on page 18.

CHP can form a major part of a hospital's overall strategy for energy and the environment. This Guide will help you to find out how CHP can work for you.

The information provided includes:

- choosing the CHP for your situation
- financing options
- project management and installation
- successful operation
- examples to show how other hospitals have benefited from CHP, and how those benefits are achieved.

WHAT IS CHP?

CHP is the generation of electricity and useful heat in a single process.

All buildings that are designed for people need energy – heat to provide warmth and hot water, and electrical power to provide light and other services.

Hospital buildings normally derive their heat and electrical power separately, heat from boilers (burning gas, oil or coal) and electricity via the national grid from power stations which burn gas, oil and coal. This approach leads to two sets of losses – from the power station generator and from the local boiler.

A CHP unit eliminates some of the losses by burning fuel to generate electricity, and at the same time using the 'waste' heat to provide warmth and hot water for use in the hospital.

WHY USE CHP?

As shown in figures 1 and 2, for each unit of useful energy produced, CHP wastes less fuel than do local boilers and a power station. As fuel is expensive, CHP can provide considerable financial savings.

Burning fuels produces carbon dioxide (CO_2), which contributes to climate change, and CHP can, therefore, reduce a hospital's contribution to environmental pollution.

CHP AND THE HEALTH SECTOR

The health sector is one of the largest users of energy in the UK. There are approximately 1200 NHS hospitals in the UK, and the potential for CHP has been estimated to be greater than 570 MWe. However, in 1996 the installed capacity was only about 80 MWe. There is, therefore, significant potential for additional CHP in the NHS.

There are many reasons why the use of CHP is a good idea. CHP can be one of the best ways to save money, and if less money is being spent on energy, more money could be made available for patient care. As CHP reduces energy waste it can help to reduce health and environmental problems.

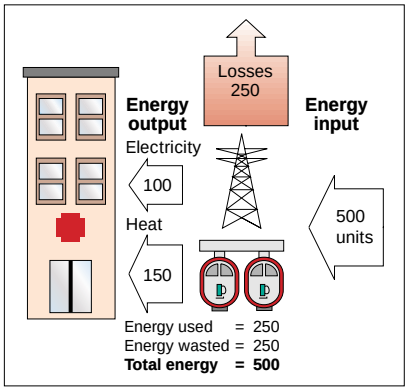

Figure 1 Electricity from grid, heat from boilers

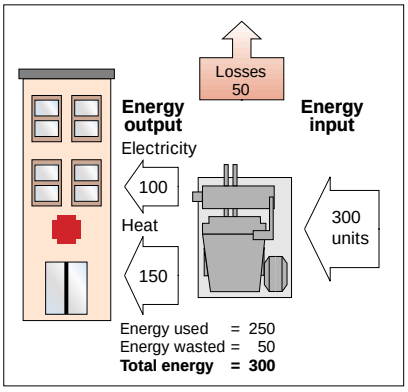

Figure 2 Electricity and heat from combined heat and power

SAVE MONEY

The principal benefit of CHP to a hospital is the financial saving that can be made. CHP can reduce the energy bill significantly. In the case studies reported in this Guide, savings of between £33 000 and £350 000 per year have been realised.

These figures must be offset against the cost of installing CHP. This varies according to the choice of payment method (these options are discussed in section 4). However, CHP systems regularly achieve a three to five year payback. Over their lifetime, internal rates of return above 15% can be realised.

IMPROVED SERVICES AND RELIABILITY

In today's financial climate, hospital managers are under pressure to provide high-quality building services that offer the best possible value for money.

It is inevitable that breakdowns and maintenance affect heating and power supply. By augmenting or replacing existing plant, CHP can considerably improve the quality and reliability of the services. CHP can even be configured to increase the capacity of on-site standby generation in the event of a power cut.

MORE MONEY FOR PATIENT CARE

Money spent on heating and electricity is largely a fixed overhead – ie whether a ward is full or half full it costs about the same to provide it with heat and power.

CHP reduces overhead costs by reducing the amount of primary energy consumption at the generating plant. If resulting savings are spent directly on patient care, more patients could be treated, and efficiency in terms of the cost per patient is further improved.

Photograph produced by permission of Northampton Chronicle & Echo.

Figure 3 Volunteers being made up as mock 'casualties' during an exercise at Northampton General. The hospital's CHP plant provided heating when a boiler failure was simulated

SAVINGS IN A SMALL HOSPITAL

The Montagu hospital is a 113-bed community and acute services hospital that is saving £100 000 each year from CHP.

A CHP plant integrated with building energy management system (BEMS) control, boiler and heating system has enabled energy cost savings over and above those expected. A small budget has been set up using these additional funds to support further energy efficiency schemes.

The unit has performed so well that the Trust is considering a much larger CHP plant for the Doncaster Royal Infirmary.

COMBINED HEAT AND POWER AS BACKUP

Northampton General has operated a CHP plant since 1989. During a major incident exercise, the hospital's response to a simulated serious accident with large numbers of 'casualties' was tested.

The hospital thought it important to simulate a total boiler failure. This catastrophic boiler house failure meant that no heat or hot water could be produced.

CHP saved the day by supplying the hospital with its essential heat and electricity. 'Patients' continued to receive the best care and attention through the use of CHP as an emergency backup.

BENEFITS OF CHP

BEFORE YOU BEGIN!

CHP is ideal in many hospitals but careful appraisal is needed. Remember that a decision is only as reliable as the information on which it is based.

Before you begin to consider seriously which CHP option is best in your circumstances, some basic information must be collected. This should include:

- which buildings the CHP will serve
- distribution type (eg steam or water)
- locations available for the CHP plant
- daily and annual demand profiles for electricity and heat
- fuel and electricity tariffs and monthly bills
- potential site developments
- availability of finance.

Use this information to conduct a brief initial overview of CHP with respect to the particular site. This brief assessment will estimate the potential benefits to the hospital prior to significant use of time and resources.

When sizing the CHP plant, it is important that all other no-cost and low-cost energy efficiency measures have been taken into account. This will help to avoid installing incorrectly sized plant. Measures that are implemented to reduce running costs may also lead to capital savings if the size of CHP unit required can be reduced. Future changes in energy requirements should also be considered, especially the possibility of reductions in heat or power demands.

Good Practice Guide (GPG) 227 'How to appraise CHP' provides a useful methodology for conducting a preliminary investment appraisal of CHP.

ENVIRONMENTAL BENEFITS

CHP offers considerable benefits to the global environment. The most serious environmental problem at present is climate change caused by global warming.

CHP reduces consumption of fossil fuel. This, in turn, reduces the amount of CO_2 released into the atmosphere.

CO_2 is the largest contributor to global warming, and reducing its production will help combat climate change.

APPRAISAL

CHP should always be considered as part of an energy management strategy alongside other energy efficiency measures, eg insulation and heating and lighting controls. CHP choice is affected by:

- the size of demand – a site with an average electricity demand below 100 kW is unlikely to be suitable
- estate changes – significant increases or decreases in the size of hospital estates will affect energy consumption and hence optimum CHP size
- the heating system – a site with steam or medium-pressure hot water distribution is unlikely to be suitable if electricity demand is below 1 MW
- boiler location – a site with many distributed boilers is less attractive than a centralised boiler house
- the potential income generation from exporting excess electricity
- the condition of existing services – CHP will not make optimum savings if connected into systems at the end of their working life.

There are exceptions to the above criteria, and a feasibility study (in-house or using consultants) is essential. If comprehensive information is available, an initial low-cost appraisal can be performed by site staff. This will indicate the potential benefits of CHP and enable a decision to be made on a more comprehensive assessment using expert consultancy advice.

Correct sizing of CHP is crucial to the viability of a scheme. Guidance on sizing CHP units is available in GPG 227 and using the EEBPp CHP sizing software (available by contacting the Environment and Energy Helpline on tel 0800 585794)..

FINANCE

If the hospital buys the CHP unit itself, it may be limited to a smaller unit, depending on available resources (see section 4 for funding options).

Energy services companies can provide the capital for CHP, and for additional work if necessary. As the hospital pays only for the energy required, all responsibility for checking feasibility and ensuring savings lies with the contractor.

For all of these options, the manager will need to ensure that the feasibility work is completed properly.

PROJECT MANAGEMENT

The many variables to be considered can make the decision-making process complex and time consuming. To prevent confusion, a small number of people with clear roles should have responsibility for the project.

During the feasibility stages, a steering group of representatives from the relevant departments will help to provide focus and report on progress.

Expertise will be required in building services/plant engineering, finance, maintenance, and project management. The talents of a number of staff may be required.

Ensure that there are sufficient resources for a thorough job, as mistakes can be costly. Ongoing resources will also be required to ensure the CHP continues to provide value for money.

It may be necessary to consider outside consultants to help at this stage. There are also many organisations that offer advice, and these are listed on page 18.

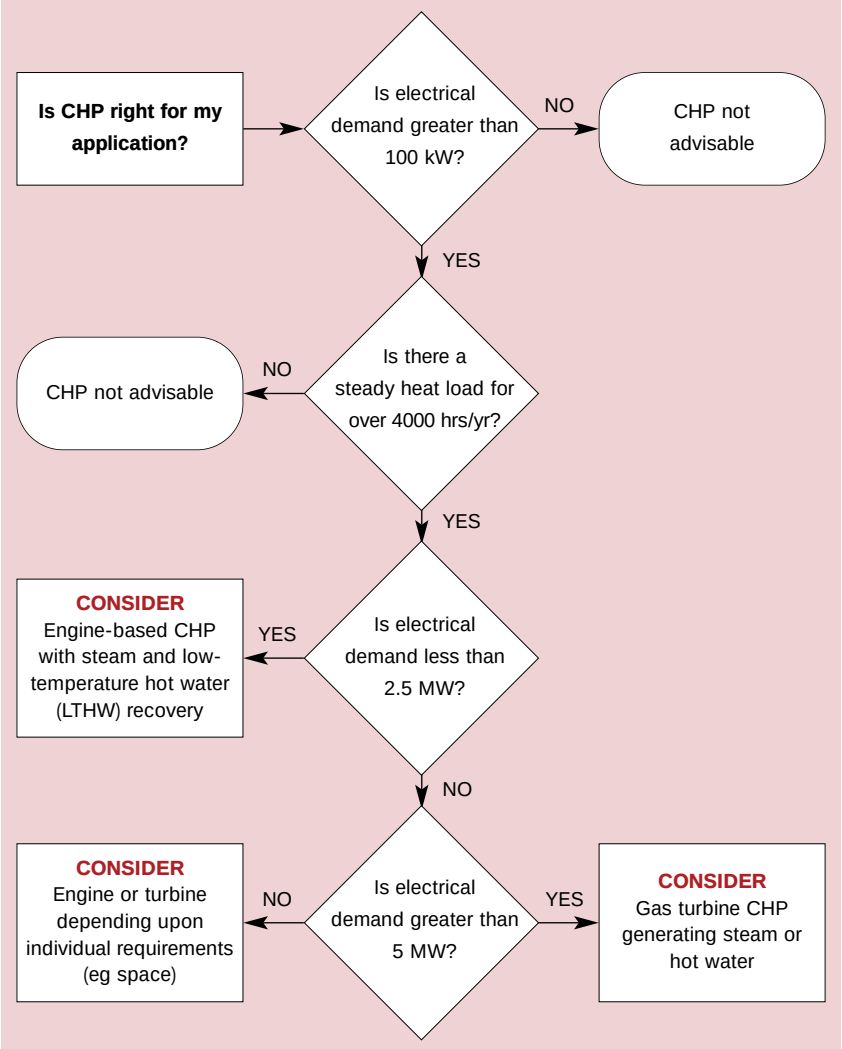

Figure 4 Decision chart

USING CONSULTANTS...

Trust staff at Poole Hospital were interested in CHP after reading the Government's Energy Efficiency Best Practice programme literature, and arranged a feasibility study by outside consultants.

A number of technical and financial options were considered and potential savings from the CHP helped to justify modernisation of the boiler house.

The result is a CHP plant that can provide the hospital's entire summer heating requirement. The performance of the installation has helped the Trust to justify installation of a second CHP unit.

...OR AN IN-HOUSE FEASIBILITY STUDY

An in-house feasibility study at Freeman Hospital ensured maximum savings by closely matching site heat demands and selling excess electricity to the National Grid.

Absorption chillers were installed to use CHP heat energy for cooling in summer.

An integrated site development philosophy has ensured reduced noise levels and that heat for new buildings will also be provided by the CHP.

HOW MUCH DOES CHP COST?

The cost of installing CHP depends upon the type, size and the ease of installation.

Although CHP installations in the NHS have capital values of between £50 000 and £5 million, most are below £1 million.

For most hospitals, CHP size will be below 2 MW of electrical output and will cost between £500 and £800 per kW. Costs can be reduced if installation is considered at the same time as boiler house redevelopment or major site infrastructure changes.

A detailed feasibility study will identify site-specific costs. Such a study should identify potential capital savings from integration with other projects and avoidance of capital expenditure (eg reducing boiler capacity).

Available sources of funding depend on the project cost. This applies whether the Trust wishes to use capital or private finance.

NHS BUSINESS CASES

A business case must be made to the NHS Management Executive for capital expenditure above the internal spending limits.

The business case will be developed with feedback from the NHS Management Executive during development. Guidelines for this procedure are published in the NHS Estates Capital Investment Manual.

Comparisons must be made between the case for using capital funds and the case for using private funds. There is no guarantee that funding will be made available.

CHP business cases have been made successfully in the recent past. However, it is necessary to convince management that the project offers value for money at an acceptable level of risk.

The main steps in making a business case are as follows.

- Assemble a business case team, including a project manager and technical, financial and other appropriate experts.
- Set the investment in the strategic context of the hospital.
- Define objectives and benefit criteria.
- Compare CHP against other options.
- Assess risk sensitivity.
- Identify the preferred option.
- Present an outline of the business case.
- Review and develop the preferred option.
- Present a full business case.

HOW WILL YOU FUND YOUR CHP PLANT?

- Internal funding.
- Energy services approach
  – discount energy purchase
  – contract energy management.
- Private Finance Initiative.

INTERNAL FUNDING

Capital funding should be considered as an option for all CHP schemes, especially for smaller, straightforward installations. Its main benefit is that complete control over the CHP can be retained, and savings can be maximised.

However, the Trust will retain the risk of the asset not performing. To minimise this risk, the project should be based on a sound business case and incorporate regular review mechanisms.

SAVINGS PROMOTE CHP

An 85 kW CHP unit was installed at Northampton General as a trial by the then Oxford Regional Health Authority. From the savings made, hospital staff decided that additional units would be beneficial.

The business cases for subsequent units were strengthened by the demonstrated savings that this unit achieved.

Consequently, two more CHP units have been installed at a cost of £180 000 each, and payback may be achieved in less than five years.

THE SMALL HOSPITAL

Staff at the Montagu Hospital based their business case on the preferred option in a consultant's feasibility report.

The CHP plant was appraised simultaneously with significant works to the boiler house and services, including a change from steam distribution to low-temperature hot water (LTHW).

For a total project cost of £485 000, the CHP plant was expected to save £79 000 per year, but has actually saved as much as £100 000 per year!

DISCOUNT ENERGY PURCHASE (DEP) PROVES A CHEAP OPTION

Having compared outright purchase with five-year and 10-year DEP, Poole Hospital found that, in its case, a 10-year DEP contract (with 90% guaranteed availability) was the cheapest option.

Over the contract period, the hospital estimated that it can gain savings of £90 000 more than the savings obtainable by capital purchase.

With no need for capital investment, and savings guaranteed by the supplier, producing a successful business case was simple.

Figure 5 An aerial view of the Montagu Hospital

CHP maintenance can also be contracted out (usually to the equipment supplier) with a guaranteed level of availability over a 1-10 year period. Although slightly more expensive, this approach ensures that the expected savings are achieved and minimises the Trust's exposure to breakdown repair costs.

Capital funding should not be considered where the Trust cannot devote time and resources to design, project management and ongoing audit of the installation.

The CHP study should consider the effect of capital charges on the project, including avoided charges from plant replaced and reduced capital spend.

EXTERNAL FUNDING OPTIONS

Alternative finance of CHP in hospitals is increasingly common. Energy and cost savings can be obtained without risking the capital. However, all options need careful scrutiny to ensure appropriate risk transfer and value for money.

Although design costs and risks are removed, the hospital must ensure that it uses suitable expertise to scrutinise the technical, financial and legal proposals.

ENERGY SERVICES APPROACH

Energy services contracts can take the concept further by removing the hospital's responsibility for all energy services up to the point of use.

In entering an agreement with an energy services company (ESCO), the contractor maintains agreed conditions in the building. This may be, for example, 21ºC and five air changes per hour.

The means by which contract conditions are met is solely the responsibility of the contractor.

Discount energy purchase (DEP)

DEP is also known as equipment supplier finance, and in this option the CHP supplier pays for, maintains and owns the installed CHP.

The hospital buys units of electricity from the CHP at a price lower than that for mains electricity, but higher than cost. This allows the supplier to recover

costs. Gas costs are usually paid by the hospital, but heat is normally provided free of charge.

A major benefit of DEP is the guaranteed CHP operation and performance. If the CHP fails to perform, the hospital still makes savings, as the supplier must supply electricity at the contract price.

Contracts normally run for five years and upwards, during which time the hospital buys a set amount of electricity. When the contract ends, the hospital either owns the CHP or can exercise a purchase option.

Contract energy management (CEM)

CEM is typically used for large, capital-intensive projects, including those where building work, refurbishment and improvements are required.

A contractor designs and finances the work, and is contracted to provide the energy supply to all or part of the site.

Installation of CHP often forms part of the contract as it provides a controllable cost. The hospital buys energy (heat and power) from the contractor at a set tariff, normally in the form of a standing charge and unit rate for each service.

A profit margin on the unit price of this energy and the standing charge allow the contractor to recoup the cost of investment. The hospital saves money via reduced overall energy costs.

Contracts tend to be in excess of seven years in order to reduce the capital element of the costs. Once the contract comes to an end, the plant can become the property of the hospital, subject to accounting treatment.

PRIVATE FINANCE INITIATIVE

Funding of a CHP supply may be possible under the Private Finance Initiative (PFI). The principal advantage is that the operational risks are transferrred to the private sector in return for a regular service charge.

A £3.5 MILLION CONTRACT ENERGY MANAGEMENT INVESTMENT

Freeman Hospital has awarded a 15-year CEM contract to AHS Emstar (now Dalkia). As part of the contract, two 1.25 MWe CHP engines, new boilers and absorption chillers have been installed at a cost of £3.5 million.

The CHP is guaranteed to run at 90% availability (18 GWh each year) and it is estimated that the hospital is saving £200 000 per year.

Dalkia is paid on a fixed-price basis as this encourages efficient operation.

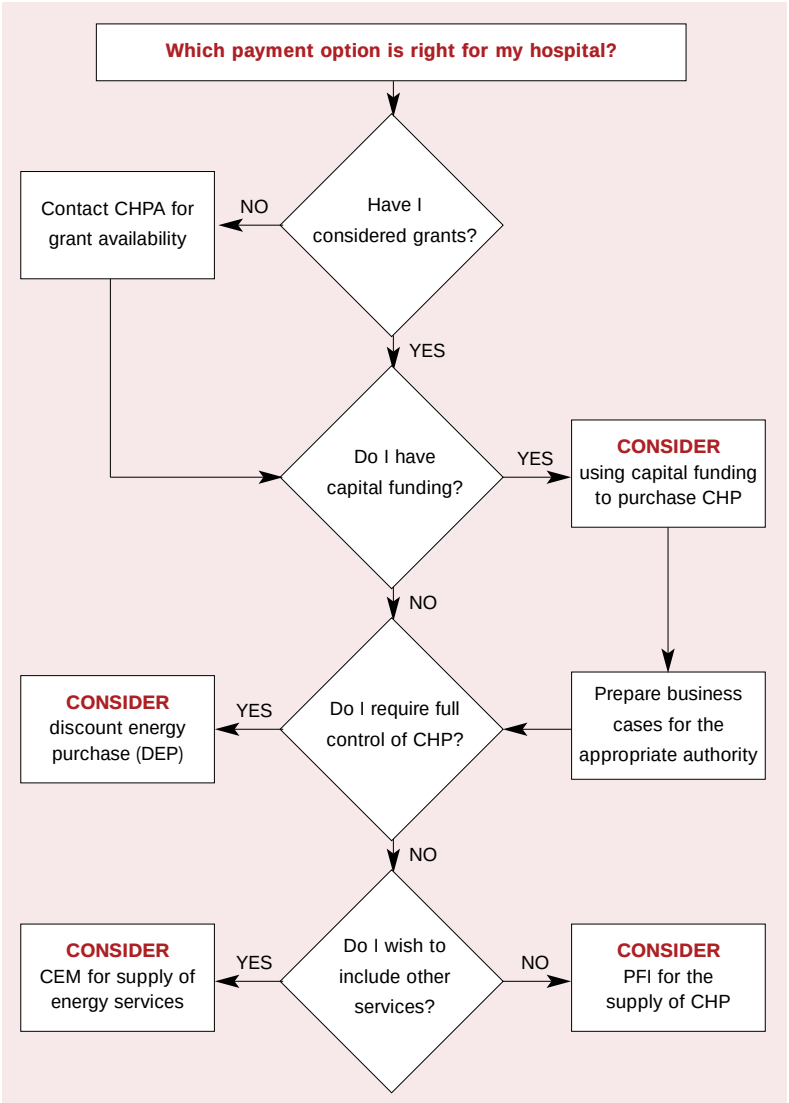

Figure 6 Which payment option is right for my hospital?

5 INSTALLING CHP

MANAGING THE INSTALLATION

At the decision-making stage of the project, a small number of people with clear roles should have held responsibility for managing the project.

This 'steering group' should be used to provide focus and report on progress during installation of the CHP. This should ensure continuity while keeping all interested parties informed of progress.

Regular meetings should be held, with a clear agenda for tracking the project and setting deliverables. Many successful projects include the manufacturer, engineer and contractor in these meetings.

HOW IS A CHP UNIT INSTALLED?

Most hospital CHP units are supplied as complete packaged units. They require a suitable base, but are otherwise ready to be connected to site power, fuel and heating.

Figure 7 A combined heat and power unit being delivered at Northampton General

The unit will be delivered by HGV and put into place by crane. Suitable access will be needed.

The unit will require suitable plant space, ventilation, exhaust stack and connection to the site electrical supply. The cost of all of these items must be included when assessing financial viability.

The financial viability of CHP can depend on enabling works required for access and installation.

It is usual to run the CHP unit at the same time as, or in parallel with, the normal site electricity service. This requires approval from the local regional electricity company and may be subject to restrictions. This should be clarified during the feasibility stage.

The unit is connected into heating and electrical services via standard cables and pipework. The heating and electricity may need to be interrupted in part or in total to do this.

The installation of a heat dump radiator allows electrical output to be maintained at times of low heat demand. To minimise unnecessary loss of heat, the CHP unit should act as lead boiler to meet the biggest heat demand.

CHP units have automatic controls. These are normally linked to 24-hour monitoring services supplied under a maintenance contract. Existing BEMSs can also provide useful monitoring facilities.

WHERE TO INSTALL CHP

Hospital CHP units are typically packaged in a noise-reducing enclosure. Some flexibility in location is possible, such as a small basement or rooftop plant-room (depending on unit size and weight).

A central installation involves connecting the unit as if it were an additional boiler in the boiler house.

The best locations also have convenient access to the fuel, heating and electrical distribution systems.

MINIMISING DISRUPTION TO THE SITE

Installation should be planned to minimise disruption to patient care and maintain staff goodwill. Interruption to services, noise, dust and general inconvenience should all be assessed.

Staff should be informed of the installation work in good time. Staff opinions (in particular, concerns for patient care) should be considered.

If there is a quiet time of year in your hospital, it is best to programme work for this period.

COMMISSIONING THE CHP UNIT

Once a CHP unit has been properly installed, and is ready to run, it is vital that it is properly commissioned to ensure maximum savings. This is normally undertaken by the installer/manufacturer. Proper commissioning should ensure that the CHP:

- is running within normal operating parameters (eg speed, temperature, etc) to avoid potential reliability problems
- is controlled to provide the maximum possible savings
- is integrated with existing site services to ensure that they work to maximum efficacy
- in the case of steam systems, is operationally safe and meets the requirements of health and safety regulations.

INDEPENDENT OPERATION

Northampton General Hospital has three packaged CHP units.

The units are located in basement rooms, where there is convenient access to the secondary heating circuits and a route for the electrical cables to connect the units into the site.

By using the secondary circuits, the CHP units were designed to be operated independently of the boiler house.

MINIMAL DISRUPTION AND EARLY INSTALLATION

During installation at the Montagu Hospital, it was critical that sterilisation, heating and hot water services were maintained.

A detailed 14-month programme from design to completion of the overall CHP project was drawn up to ensure continuity of these services.

The project was completed three months ahead of schedule, and with minimal disruption to the operation of the hospital.

6 OPERATING CHP

Having installed and commissioned CHP, it is vital to ensure that the unit continues to perform efficiently and make savings.

ESSENTIAL MAINTENANCE

As a hospital CHP unit can run 24 hours a day, 365 days a year, there are essential maintenance requirements. It is easy to operate a perfectly good CHP unit at a loss because of poor preventive maintenance, especially if performance is not guaranteed by a contract. For every minute that the CHP unit is not running, savings are lost.

A structured maintenance programme will enable scheduled down-time for the CHP at times when alternative energy sources are least costly. This approach is cost-effective as it reduces the risk of expensive emergency work. Liaison with the manufacturer of the unit will identify the best maintenance regime.

Figure 8 The combined heat and power control room at QMC Nottingham

It is possible to contract guaranteed performance levels from a CHP maintenance contractor for a small extra premium. This ensures financial savings even if the unit is not running.

As mentioned previously, DEP and CEM can be attractive choices. Both types of contract pass on financial responsibility for CHP operation and maintenance to the contractor, and hence guarantee savings.

ENSURING PROPER CONTROL

Proper control of the CHP and heating systems is essential for making savings.

If CHP is poorly sequenced with the boilers, it will not run for long enough and/or will dump useful heat. These situations can mean that the CHP system operates at a loss.

Thorough commissioning is essential to ensure correct installation and setup of controls. Frequent checks should ensure that the control regime does not slip.

Where possible, connect the CHP unit to an existing BEMS. This can then control the CHP as part of the whole heating system. Alarms can be used to warn of problems, and changes to set points can be made from a central computer.

MONITORING PERFORMANCE

Effective metering allows accurate monthly reporting of CHP performance. It can also warn of potential problems.

It is necessary to meter the fuel consumed, hours run, electricity and heat produced. Do not use estimates because these can hide problems.

Use this information to report monthly CHP performance and savings. Some manufacturers can monitor their CHP units remotely to provide performance reports.

CONTRACT OPERATION OF CHP

A 4.5 MW gas turbine CHP is operated by Yorkshire Electricity at QMC Nottingham.

Under a CEM contract, the supplier is responsible for operation and maintenance. However, Trust staff perform first-line duties and are trained in basic maintenance procedures.

The Trust has engaged an independent consultancy to audit performance to ensure that the £350 000 annual savings are met.

CONTRACT GUARANTEES OPERATION

Northampton General Hospital contracts the monitoring and maintenance of its CHP system to the manufacturer, who guarantees 90% availability.

Monitoring can be undertaken remotely by phone line and computer.

However, the site energy manager ensures that the units are performing well by analysing the monthly reports. Energy management software is used, which automates the calculation of savings and performance.

FREEMAN HOSPITAL, NEWCASTLE

Trust	Freeman Group of Hospitals NHS Trust
Size	806 beds
Type	Acute services
CHP	2 × 1.35 MWe
Date	1997
Engine	Spark ignition
Funded	Energy services
Provider	Dalkia
Saving	£200 000 per year

MONTAGU HOSPITAL, MEXBOROUGH

Trust	Doncaster Royal Infirmary and Montagu Hospital NHS Trust
Size	113 beds
Type	Community and acute services
CHP	1 × 110 kWe
Date	1995
Engine	Spark ignition
Funded	Capital purchase
Saving	£100 000 per year

QMC NOTTINGHAM

Trust	QMC Nottingham NHS Trust
Size	1400 beds
Type	Acute services/university hospital
CHP	1 × 4.9 MWe
Date	1998
Engine	Gas turbine
Funded	Energy services
Provider	Yorkshire Electricity
Saving	£350 000 per year

NORTHAMPTON GENERAL HOSPITAL

Trust	Northampton General Hospital NHS Trust
Size	740 beds
Type	Acute services
CHP	1 × 85 kWe (region funded) 1 × 220 kWe 1 × 450 kWe
Date	1989, 1995 and 1997
Engine	Spark ignition
Funded	Capital purchase
Saving	£70 000 per year

POOLE HOSPITAL, DORSET

Trust	Poole Hospital NHS Trust
Size	720 beds
Type	Acute services
CHP	1 × 380 kWe
Date	1994
Engine	Spark ignition
Funded	Discount energy purchase
Provider	Nedalo
Saving	£33 000 per year

8 WHO SHOULD BE RESPONSIBLE FOR WHICH ACTIONS?

A senior board member should:

- establish commitment to evaluate the case for CHP
- instruct the estates department to consider CHP options
- consider use of CHP in marketing the hospital
- consider CHP within the hospital's overall policy for environment and energy.

The estates director should:

- consider the preliminary case for CHP
- establish commitment at all levels
- involve the finance department in proposals
- obtain information on long-term plans, eg decentralisation
- request an initial feasibility study
- investigate and visit existing schemes
- take responsibility for achieving approvals.

The finance director should:

- explore various contract types for value for money
- liaise with the estates department to determine the potential scope of the project.

The engineer or energy manager should:

- investigate large and small sites for CHP
- obtain key information such as energy usage data
- obtain background information and investigate possible consultants
- contact electricity and gas supply companies to discuss supply contracts and tariffs.

9 JARGON BUSTER

Contractual	
Capital purchase	A funding option where the hospital buys plant (CHP) using its own funds.
Contract energy management (CEM)	A service providing technical, financial and management resources to implement an energy-saving project. Remuneration for the service is often by retention of a proportion of the savings. The CEM contractor can also bear a higher proportion of the financial risk of any investment. (CIBSE Applications Manual AM12: 1999, 'Small-scale combined heat and power for buildings', appendix 1)
Discount energy purchase (DEP)	A method of financing CHP where the supplier installs the plant at his own cost. The supplier recovers costs by charging the hospital at a discounted rate for a set amount of electricity and/or heat.
Energy services contract	As CEM, but the supplier is contracted to maintain predetermined conditions in buildings (eg 21°C) and accepts responsibility for the entire heating system up to point of delivery. Energy services contracts may be worded to define the outcome of the service provided, temperatures and light levels, rather than how much energy is to be supplied. (CIBSE Applications Manual AM12: 1999, 'Small-scale combined heat and power for buildings', appendix 1)
Energy services company (ESCO)	Companies offering a total energy supply service who take responsibility for provision, financing, operation and maintenance of energy facilities. (CIBSE Applications Manual AM12: 1999, 'Small-scale combined heat and power for buildings', appendix 1)
Export electricity	Electricity generated in excess of site demand which can be sold to other users or to the electricity supplier if suitable metering and contract conditions exist.
Private Finance Initiative (PFI)	A funding option whereby an external contractor (from the private sector) provides the CHP and services in return for an ongoing fee.

Technical	
Absorption chiller	Equipment that uses heat energy to produce chilled water for use in air-conditioning. Often uses spare CHP heat in the summer when buildings require cooling.
Building management system (BMS)	An electronic control system for building services usually linked to a central computer control system.
Combined heat and power (CHP)	Simultaneous generation of electricity and production of heat using a source of mechanical and thermal energy (eg reciprocating engine, gas turbine or steam turbine).
Compression ignition	Ignition of the fuel in an engine using compression on the principle of a diesel car engine.
Distribution	Heat transport around a hospital from central boilers. Distribution mains are pipes through which hot water (LTHW or MPHW) or steam flows.
Domestic hot water	Hot water required by people for day-to-day purposes (washing up, bathing, etc).
Engine	Type of CHP, spark ignition or compression ignition reciprocating engine fuelled by gas or oil.
Gas turbine	A type of CHP, essentially a 'jet engine' fuelled by gas, oil or both.
Heat dump	A means by which some heat from a CHP can be dumped to allow maximum electricity generation.
Low-temperature hot water (LTHW)	Water, typically at 70ºC to 80ºC and which may or may not be pressurised. Low pressure hot water (LPHW) is sometimes used when water is not under pressure.
Medium-pressure hot water (MPHW)	Water at temperatures between 120ºC and 133ºC and pressure between 200 kPa and 300 kPa.
MWe	Mega Watt of electrical energy.
Packaged CHP	A self-contained CHP unit with all necessary equipment, often in a sound-insulated casing.
Remote monitoring	A CHP control system which reports performance and problems automatically via telephone to the maintenance contractor.
Spark ignition	Ignition of the fuel in an engine, using spark plugs on the principle of a petrol car engine.
Steam	A common medium for distribution of heat. Steam is essential in hospitals for sterilisation.
General	
Availability	The percentage of time that a CHP unit can be used. Reduced below 100% by maintenance and breakdown.
Building services	The utilities/services required for operation of a building. Building services include water, heating, domestic hot water, air-conditioning and electricity. More specialist hospital services include steam, and oxygen.
Decentralisation	Replacing central boiler plant and distribution with boilers for each building. The decision to decentralise depends on the cost of maintaining heat mains and the need for fuel storage.
Reliability	The percentage of time that a CHP unit can be used when required to do so (eg outside scheduled down-time).
Stack	Chimney or flue through which waste gases are exhausted by a CHP, boilers, incinerator or other process.
Standby	Generation capacity on site which provides electricity (or other building services) during supply failure.
Utilisation	The percentage of time that the CHP is operated at full output (or equivalent).

FURTHER INFORMATION

The organisations listed below can help in various ways.

- For lists of suppliers contractors and consultants, contact the Combined Heat and Power Association (CHPA), and the Institute of Energy.
- To find out more about CHP, contact the Chartered Institution of Building Services Engineers (CIBSE).
- To find out more about CHP and possible grants, contact the CHPA.

Environment and Energy Helpline

Free help and advice on lowering energy use and reducing waste is available from the Government's Environment and Energy Helpline on 0800 585794. Most organisations can save at least 1% of their turnover by carrying out a waste minimisation programme and reduce their energy bills by up to 20%. The Helpline can advise you how to achieve this in your NHS Trust. Furthermore, a free site visit can be arranged for smaller businesses at the Helpline manager's discretion.

CHP Club

The CHP Club (www.chpclub.com) is the Energy Efficiency Best Practice programme's (EEBPp) gateway to the support services users need when making that CHP investment decision. It is a user-focused forum where CHP users and potential users can access information, exchange experiences, ask questions and share good practice.

Combined Heat and Power Association (CHPA)

35-37 Grosvenor Gardens, London SW1W 0BS
Tel 020 7828 4077. Fax 020 7828 0310
Internet www.chpa.co.uk

Institute of Energy

18 Devonshire Street, London W1N 2AU
Tel 020 7580 7124. Fax 020 7580 4420
Internet www.instenergy.org.uk

Chartered Institution of Building Services Engineers (CIBSE)

222 Balham High Road, London SW12 9BS
Tel 020 8675 5211. Fax 020 8675 5449
Internet www.cibse.org

ENERGY EFFICIENCY BEST PRACTICE PROGRAMME DOCUMENTS

The following Best Practice programme publications are available from BRECSU Enquiries Bureau. Contact details are given on the back cover.

Good Practice Guides

1 Guidance notes for the implementation of small scale packaged combined heat and power
3 Introduction to small scale combined heat and power
43 Introduction to large scale combined heat and power (available from ETSU)
54 Electricity savings in hospitals. A guide for energy and estate managers
115 An environmental guide to small scale combined heat and power (available from ETSU)
176 Small scale combined heat and power for buildings
182 Heating system option appraisal – a manager's guide
187 Heating system option appraisal – an engineer's guide for existing buildings
227 How to appraise CHP. A simple investment appraisal methodology

THIS GUIDE IS BASED ON MATERIAL DRAFTED BY CAPITA UNDER CONTRACT TO BRECSU FOR THE ENERGY EFFICIENCY BEST PRACTICE PROGRAMME

The Government's Energy Efficiency Best Practice programme provides impartial, authoritative information on energy efficiency techniques and technologies in industry and buildings. This information is disseminated through publications, videos and software, together with seminars, workshops and other events. Publications within the Best Practice programme are shown opposite.

Visit the website at **www.energy-efficiency.gov.uk**

For further information on:

Buildings-related projects contact:
Enquiries Bureau

BRECSU
BRE
Garston, Watford WD2 7JR
Tel 01923 664258
Fax 01923 664787
E-mail brecsuenq@bre.co.uk

Industrial projects contact:
Energy Efficiency Enquiries Bureau

ETSU
Harwell, Oxfordshire
OX11 0RA
Tel 01235 436747
Fax 01235 433066
E-mail etsuenq@aeat.co.uk

Energy Consumption Guides: compare energy use in specific processes, operations, plant and building types.

Good Practice: promotes proven energy-efficient techniques through Guides and Case Studies.

New Practice: monitors first commercial applications of new energy efficiency measures.

Future Practice: reports on joint R&D ventures into new energy efficiency measures.

General Information: describes concepts and approaches yet to be fully established as good practice.

Fuel Efficiency Booklets: give detailed information on specific technologies and techniques.

Introduction to Energy Efficiency: helps new energy managers understand the use and costs of heating, lighting, etc.